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Burkholderia sp. with a special note on its infection in NICU care - Review

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Abstract- Burkholderia cepacia is a gram negative bacilli usually isolated from persons with genetic lung diseases such as Cystic fibrosis. It was discovered as a plant pathogen but later researchers have found it to be a notorious pathogen in humans. It is also a nosocomial pathogen which contaminates equipment and even disinfectants. In the other end of the spectrum, research suggests that these organisms maybe used as bio diesel and also as pesticides and fertilizers. This review of literature gives an idea of the organism and the gateway it opens for further research with a special note on the evolution of this genus as a nosocomial infection in Neonates.

Index Terms- Burkholderia, Neonates, NICU, India

I. INTRODUCTION

Burkholderia cepacia was first discovered by Walter Burkholder of Cornell University in 1949 as the cause of bacterial rot of onion bulbs (1). Organism formerly known as Pseudomonas cepacia has been reclassified as Burkholderia cepacia because the base sequence of its DNA was found to be significantly different from the DNA of the members of the genus Pseudomonas (2). Later, the organism has been identified to be capable of degrading more than 100 different organic molecules. This capability is often a factor in the contamination of equipment, drugs and also in disinfectant solutions in the hospitals thus evolving the organism as a notorious Nosocomial pathogen. It most often causes Pneumonia in individuals with underlying lung disease such as cystic fibrosis (3).

II. EPIDEMIOLOGY AND TRANSMISSION

Burkholderia cepacia complex often have antifungal, anti nematodal or plant promoting properties which makes them attractive as biological pesticides and fertilizers (4). Because of their nutritional versatility, Burkholderia cepacia complex bacteria also have an application for bioremediation of contaminated soils. They can be found in soil, water, infected plants, animals and humans. (5). At present there are 60 validly named species in the genus Burkholderia many of which have been isolated from soil and water samples (6)

III. CULTURE AND IDENTIFICATION

Burkholderia cepacia is a gram negative bacilli. They possess multitrichous polar flagella as well as pili used for attachment. The organism has three chromosomes and one large plasmid (7). The appearance of Burkholderia cepacia species varies based on the strain and culture medium used. At present there are three media specifically used to isolate the bacteria. They are as follows: Pseudomonas cepacia agar (PCA), oxidation fermentation bacitracin lactose agar (OFBLA) and Burkholderia cepacia selective agar (BCA). The BCA has proved to be the most effective of the three, because of its ability to suppress the non- Burkholderia cepacia bacteria. The organism can also be cultivated in MacConkey agar or Muller Hilton agar. After 24 hours the bacteria are visible as pinpoint colonies. The organism needs 3 days of incubation. In MacConkey agar, after extensive incubation they become dark pink to red due to oxidation of lactose (8). However, accurate identification of Burkholderia cepacia species presents a challenge (9).

IV. UNIQUE FEATURES OF BURKHOLDERIA

Burkholderia cepacia has the ability to use the chlorinated aromatic compound 2, 4, 5 – trichlorophenoxyacetic acid as a source of carbon and energy. This compound is usually used in agriculture as a pesticides, herbicides and preservatives. Burkholderia, thus by breaking it down, eliminates the compound from the environment. (10)

Burkholderia differs from most other pseudomonads in that it has higher levels of the enzyme 4-phospho-gluconate dehydrogenase. This enzyme is used in the pentose shunt pathway (11).

Burkholderia possess an inducible β-lactamase which is what allows the organism to catabolize the β-lactam antibiotics such as Penicillin. They are thus one among the most antimicrobial resistant bacteria encountered in the clinical laboratory. They are also resustant to aminoglycoside and polymyxin antibiotics (12). However, Burkholderia are usually susceptible to Piperacillin, Azlocillin, Cefoperaxone, Ceftazidime, Chloramphenicol and Trimethoprim-Sulfamethoxazole (13).

V. PATHOLOGY

In humans it is well known for its infection in cystic fibrosis patients as well as patients with chronic granulomatous disease and other patients with compromised immune systems. All species within the Burkholderia cepacia complex have been isolated from cystic fibrosis patients, however Burkholderia cenocepacia and Burkholderia multivorans seem to cause the majority of infections.(14) Many patients develop what is known as “Cepacia syndrome” which is a fatal Necrotizing pneumonia that is currently untreatable.

Apart from patients with cystic fibrosis, Burkholderia may also affect non- cystic fibrosis patients, even non-immunocompromised individuals. The organism has been

associated with cutaneous foot lesions in military personnel, a malady known as "swamp foot".

As it can infect hospital soaps and disinfectants, individuals working in hospitals are not necessarily safe. Because cross infection is so prevalent, it is important that infected patients be segregated from non-infected patients.(15)

VI. RISING INFECTIONS IN NEONATES

Recently there have been several outbreaks of this organism in NICU set up. Burkholderia cepacia was isolated four times from clinical specimens in Neonatal Unit (NU) of Southern Health-Monash Medical Centre, Clayton, Victoria, Australia from 2000 to 2005 and only once from 1994 to 2000. (16) An outbreak of *Burkholderia cepacia* septicaemia occurred in the NU of Kuala Terengganu Hospital, Malaysia over a 9-week period in 2001, affecting 23 babies and two died. A second outbreak lasting 8 days occurred a year later, affecting five babies (17). There was an outbreak in Japan reported in the year 2010 where there were 6 cases reported in that year. Among them, one isolate was found in peripheral blood apparently giving rise to a systemic infection (18). In India, in the year 2001 to 2006 the case fatality rate of Burkholderia was reported as 40 in a study conducted in Chandigarh (19). BCC was isolated from 6 Cystic fibrosis infants admitted in PGIMER, Chandigarh between April 2009 and March 2010 (20). Our review of literature suggests that there has been only one case reported with Burkholderia in the Pleural Fluid in a Neonate (21).

VII. ONGOING RESEARCH

Apart from being dreaded as a nosocomial pathogen, Burkholderia cepacia is an effective bio agent in the creation of biodiesel in order to help eliminate harmful waste being released into the atmosphere by petroleum and diesel (22). Burkholderia has also found to be useful in agriculture industry to protect plants from pathogen. Burkholderia can colonize the roots of many plants where it produces compounds that protect against soil borne pathogens. It can also be used in bioremediation because of its ability to metabolize toxic compounds like 2, 4, 5-trichlorophenoxyacetic acid, a major component of Agent Orange (23).

VIII. CONCLUSION

Burkholderia cepacia offers a wide range of possibilities and research opportunities in the fields of medicine, agriculture and engineering. The following quote beautifully depicts the nature and the uniqueness of this micro-organism; "*What better microbial challenge to unite agricultural and medical microbiologists than an organism that reduces an onion to a macerated pulp, protects other crops from bacterial and fungal disease, devastates the health and social life of cystic fibrosis patients, and not only is resistant to the most famous of antibiotics, penicillin, but can use it as a nutrient!*" (J. R. W. Govan, 1998)

As it is a contaminant of disinfectants itself, further research is needed as to which disinfectants are safe to use and protect us from this organism. Studies that suggest its use in bio diesel and bioremediation must also focus on how the addition of this species into the environment would affect its ability to cause disease.

REFERENCES

[1] Burkholder WH (1950). "Sour skin, a bacterial rot of onion bulbs". *Phytopathology* **40**: 115–7.

[2] "Medical Microbiology & Immunology" VII th edition. Warren Levinson, Ernest Jawatz, Mc Graw Hill. A division of Mc Graw Hill. International edition 2003. P.21

[3] Microbiology VIII th edition. Gerard J Tortoka, Berdelv R Funks, Christina L Case. Third Indian Reprint, 2005: p.21

[4] Parke J.L. and D. Gurian Sherman, 2001. "Diversity of Burkholderia cepacia complex and implications for risk assessment of biological control strains" Annu. Rev. Phytopathology 39:225-228

[5] Govan,J.R., J.E.Hughes and P.Vandamme. 1996. Burkholderia Cepacia. Medical, taxonomic and ecological issuses. J. Med. Microbiol 45:395-407.

[6] Manual of Clinical Microbiology 10th edition. Volume I. James Versalovic, Karen C. Caroll, Guido Funkey, James.H. Jorgensen, Marie Louise Landry, David W. Warnock. P.694

[7] Rodly PD, Romling U, Tummler B. "A Physical genome map of the Burkholderia cepacia type strain" Mol. Microbiology 1995; 17:57-67

[8] Henry . D, M. Campbell, C. McGimpsy, A. Clarke, L. Louden, J.L. Burns, M. H. Roe, P. Vandamme and D. Speert. 1999. Comparison of isolation media for recovery of Burkholderia cepacia complex from Respiratory secretions of patients with cystic fibrosis. J. Clin. Microbiology 37: 1004 – 1007

[9] Mc Menamin, J.D., TM.Zaccine, T.Coenye, P.Vandamme, and J.J.Lipuma.2000. Misidentification of Burkholderia Cepacia in US cystic fibrosis treatment centres. An analysis of 1051 recent sputum isolates. Chest 117:1661-1665

[10] Department of Microbiology and Immunology, College of Medicine, University of Illinois; "Genes for 2,4,5- Trichlorophenoxyacetic Acid Metabolism in B. cepacia AC1100"

[11] Allenza, P., and Lessie, T.G. "*Burkholderia cepacia* mutants blocked in the Entner-Doudoroff pathway" Journal of Bacteriology, 1982. Volume 150. p.1340-1347.

[12] Hancock, R.E.1998. "Resisitance mechanisms in Pseudomonas aeruginosa and other non fermentative gram negative bacteria." Clin.infect. Dis127. S93-S99.

[13] Clinical Diagnosis & Management By Laboratory Methods. 20th edition. John Bernard Henry, M.D. 2001. Published by Elsevier.

[14] Andrew McDowell, Eshwar Mahenthiralingam, John E. Moore, Kerstin E. A. Dunbar, A Kevin Webb. "PCR-Based Detection and Identification of Burkholderia cepacia Complex Pathogens in Sputum from Cystic Fibrosis Patients" J Clin Microbiol. 2001 December.

[15] A. M. Jones, M. E. Dodd, A. K. Webb "*Burkholderia cepacia*: current clinical issues, environmental controversies, and ethical dilemnas" European Respiratory Journal. 2001; 17:295-301

[16] Disinfection of Burkholderia cepacia complex from non-touch taps in a neonatal nursery. Despina Kotsanas, Judith Brett, Tim J Kidd, Rhonda L Stuart, Tony M Korman Southern Health-Monash Medical Centre, Clayton, Victoria, Australia. Journal of Perinatal Medicine 02/2008; 36(3):235-9. DOI:10.1515/JPM.2008.038

[17] Two outbreaks of Burkholderia cepacia nosocomial infection in a neonatal intensive care unit - Jimmy KF Lee. Journal of paediatrics and Child Health Volume 44, Issue 1-2, Pages 62-66, January/February 2008

[18] K Kuzumoto, N Kubota, K Ishii, K Yumoto, Y Ogiso, T Nakamura, T Katsuyama, K Oana and Y Kawakami "Successful cessation of transmitting healthcare-associated infections due to Burkholderia cepacia complex in a neonatal intensive care unit in a Japanese children's hospital" Eur J Med Res. 2011; 16(12): 537-542

[19] Blood Culture Confirmed Bacterial Sepsis in Neonates in a North Indian Tertiary Care Center: Changes over the Last Decade- Venkataseshan Sundaram, Praveen Kumar, Sourabh Dutta, Kanya Mukhopadhyay,Pallab Ray1, Vikas Gautam and Anil Narang. Jpn J Infect Dis. 2009 Jan;62(1): 46-50

[20] Vikas Gautam, Meenu Singh, Lipika Singhal, Mandeep Kaur, Ashok Kumar, and Pallab Ray "Burkholderia cepacia complex in Indian cystic fibrosis patients" Indian J Med Res 136, November 2012, pp 882-883

[21] International Journal of Scientific and Research Publications, Volume 4, Issue 3, March 2014 ISSN 22503153 "Spontaneous Pneumothorax in a Term Neonate – A case Report - P Karthikeyan, M Sathyamoorthy, P.Paramanandam, Saravana Bhavan, A Prema, M Poornima

[22] Noureddini, H., Gao, X., and Philanka, R. S. "Immobilized *Pseudomonas cepacia* lipase for biodiesel fuel production from soybean oil" Bioresource Technology, 2004. p. 769-777.

[23] Peter A. R. Vandamme "*Burkholderia cepacia*: Pandora's Box Redefined" BCCM. Edition 9-01. Article 2

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